

## FROZEN CONCENTRATED LIQUID WHOLE EGG AND METHOD OF MAKING SAME

### FIELD OF THE INVENTION

This invention is directed to a frozen concentrated liquid whole egg product and a process for making the frozen concentrated product.

### BACKGROUND OF THE INVENTION

Supplying, shipping and using large volumes of liquid egg products with extended shelf lives creates problems for both user and supplier. A supplier desires a product which is not only resistant to spoilage, but is cheaper to ship, uses less packaging than liquid whole egg, and uses less space for storage when stored by the supplier and/or user. Prior to the invention, no one has addressed the problem of not only reducing the volume of liquid whole egg being shipped to commercial users of egg products such as restaurants, but also maintaining and/or increasing the shelf life of eggs being used and shipped to large volume users of liquid egg products. Heretofore, prior workers have cooked eggs and frozen them or have separately frozen whites and yolks. These products do not address or help those who desire to freshly cook eggs and those who do not desire to mix eggs and whites prior to cooking.

U.S. Patent No. 4,388,340 to deFigueiredo et al. describes placing egg yolks and whites in separate containers for heating which will cause evaporation of water, but the heating when complete causes coagulation of the yolks and whites. Thereafter the yolks and whites are rapidly frozen. See also U.S. Patent

No. 4,382,973 to deFigueiredo et al. which also describes heating to coagulation and thereafter freezing. U.S. Patent No. 3,958,035 to Sterns et al. describes a method of manufacturing an "omelette-type" egg product where the egg whites and yolks have water added to adjust the level of water in the egg, such that the mix has from about 75-85 percent water by weight. The patent notes that whole eggs have a moisture level of about 75 weight percent and additional moisture is added to the mix. The egg product is heated to "set the egg product in the shape of a pan." The "set product" then is frozen. U.S. Patent No. 3,565,638 to Ziegler et al. describes adding water and gum with other ingredients to egg, pasteurizing the egg, and then freezing same. U.S. Patent No. 3,364,037 to Mink et al. describes treating egg whites with peroxide and thereafter freezing the egg whites. See also U.S. Patent No. 5,266,338 to Cascione et al. U.S. Patent No. 4,409,249 to Forkner describes separating yolks from whites, pasteurizing the yolk and whites, freezing the yolk (see Figure 2 at 29), and freezing the whites. U.S. Patent No. 3,857,974 to Aref et al., together with U.K. patent 1 376 972, and Canadian Patent No. 964921 describe the fast freezing egg white, egg yolk, or egg white and yolk.

#### SUMMARY OF THE INVENTION

The invention is directed to a frozen concentrated liquid whole egg product and a method for making such product. The frozen concentrated product is concentrated liquid whole egg which has at least about 33 weight percent solids and not more than about 67 weight percent water. After concentration the concentrated liquid whole egg has a viscosity at about 40°F prior to freezing or after thawing of not less than about 1,000 cps. Generally, before freezing or after thawing, the liquid whole egg product of the invention has from about 33% solids to about 49

weight percent solids without the addition of supplemental ingredients such as salt or sugar, from about 67 to about 51 weight percent water and a viscosity of from about 1,000 to about 5,000 cps at about 40°F. The frozen concentrated liquid egg product has a temperature of not more than about 10°F, and generally from about -10°F to about 10°F. For use, the frozen product is thawed and then reconstituted with water to have a moisture level of from about 77.5 weight percent to about 75.5 weight percent.

According to the process of the invention, liquid whole egg product is concentrated to a solids level (without the addition of supplemental ingredients) of at least about 33 weight percent with heat at a temperature and for a time which are effective for not substantially coagulating the egg and which are effective for removing water from the liquid whole egg such that the egg will have such solids level. Generally the liquid whole egg will be concentrated to a solids level of from about 33 to about 49 weight percent, from about 51 to about 67 weight percent water and a viscosity at about 40°F of from about 1,000 to about 5,000 cps. Generally, after heating the liquid whole egg, the egg is concentrated from about 1.5 times to about 2.1 times. After concentration, the concentrated liquid whole egg product is frozen to a temperature of from about -10°F to about 10°F. to provide the frozen concentrated liquid whole egg product of the invention.

In one aspect of the invention, liquid whole egg is concentrated by passing it over a plate, generally more than once, and gradually raising the temperature of the egg, evaporating water and increasing the solids level with each pass. In this aspect, the temperature of the plate of the evaporating plate is sufficiently close to the temperature of the egg so that "hot spots" will not develop such that the protein in the egg



The frozen concentrated product is concentrated liquid whole egg which has at least about 33 weight percent solids, not more than about 67 weight percent water and a viscosity at about 40°F prior to freezing of not less than about 1,000 cps. In one aspect, the concentrated liquid whole egg is not coagulated prior to freezing. In another aspect for large commercial applications, the liquid whole egg may be pasteurized either before or after concentration so that it may exhibit an extended shelf life after thawing. Before or after freezing the concentrated liquid whole egg product of the invention has from about 33 to about 49 weight percent solids without the addition of supplemental ingredients, such as salt or sugar, from about 67 to about 51 weight percent water and a viscosity of from about 1,000 to about 5,000 cps at about 40°F.

To make the frozen liquid whole egg product, water is gently removed from the egg to provide a solids level of at least about 33 weight percent solids. The solids level of liquid whole egg generally is about 23.5 weight percent before concentration. After evaporation of water in the liquid whole egg, the solids level of the concentrated egg is at least 33 weight percent, and in one aspect is as high as about 49 weight percent with such solids level being obtained without coagulating or "cooking" the liquid whole egg to provide the concentrated liquid whole egg.

In practicing the method of the invention to make the concentrated liquid whole egg, the egg is first pre-heated in a pre-heater, such as a plate pre-heater. Pre-heating brings cool liquid whole egg having a temperature of about 40°F to a temperature of at least about 100°F, and preferably to about 125°F. After pre-heating, the liquid whole egg is transported to an evaporator, such as a rising/falling plate evaporator where the pre-heated egg product is gradually heated to temperatures as high as 130°F. The pre-heated egg is exposed to the plate and to

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such a temperature for about 8 to about 10 seconds as it is heated in stages. Other evaporation devices, such as a batch pan evaporator, a tubular evaporator (natural circulation tubular, rising film tubular and falling film tubular evaporator), forced circulation evaporator, wiped film evaporator, and rising/falling film plate evaporator all may be used to practice the invention.

The plate in the evaporator is heated with a liquid medium, such as water, having a temperature in the range of from about 145 to about 160°F. Water in the egg is evaporated gradually by gradually heating and evaporating the water in the egg in stages. The surface of the plate has a temperature of about 105°F to about 130°F as the liquid whole egg passes over in it a first pass or stage where exposure of the egg to the plate in the plate heater is for about 8 to about 10 seconds. After the first pass or stage the egg treated in the first stage has a solids level of about 33 weight percent and may be held in a surge tank until it is redirected over the same or another evaporator plate having a surface temperature of about 105°F to about 130°F for about 8 to about 10 seconds. After such a second pass, the resulting concentrated egg will have a solids level of about 42 weight percent. The egg may be continually subjected to such evaporation treatment, such as a third pass, until the solids level of about 33 to about 49 weight percent is reached. The temperature difference between the egg and evaporation plate should not be more than about 3°F to about 6°F. This avoids overheating of the egg and denaturization and/or coagulation of the protein in the egg. The time and temperature of the pre-heating, the evaporation, and the number of "passes" through the evaporator should be effective for providing a solids level for the liquid whole egg to at least about 33 weight percent, and generally to about 49 weight percent or more without cooking or coagulating the resulting concentrated liquid whole egg. The

thickness of the stream of egg flowing over the plate also has to be controlled so that the temperature of the egg flowing over the plate will not be substantially different such that a large temperature gradient does not develop over the thickness of the egg depending upon how far a particular egg particle is from the plate of the plate evaporator. The thickness of the egg flowing over the plate for commercial applications generally may be about 3mm with the egg being heated in three stages in a rising/falling plate evaporator to a temperature of about 130°F for about 8 to about 10 seconds per stage at a flow rate of from about 1.5 to about 4 grams per minute. Generally in three passes, the liquid whole egg may be concentrated to about 49 weight percent solids by heating it at about 130°F for about 24 to about 30 seconds. The egg passing over the plate of the plate evaporator and the plate of the plate of the evaporator comprise a system which is substantially isothermal.

Before or after the concentration of the egg, the egg may be pasteurized by various known methods, such as those set forth in the Egg Pasteurization Manual published by the U.S.D.A. (140°F for 3-1/2 minutes hold time). After pasteurization the pasteurized product generally has less than about 1000 plate count per gram of concentrated product, less than about 10 E. coli and coliforms per gram of concentrated product, negative salmonellae and negative listeria.

After the water has been evaporated from the liquid whole egg, the resulting concentrated egg is frozen. This may be generally done by exposing the concentrated egg to temperatures of from about -10°F to about -20°F. using known equipment.

## EXAMPLE

### Equipment

- o 100 Gallon Processing Tank.
- o Junior Rising/Falling Film with two passes in the evaporator.

### Process

Liquid whole eggs are pumped into a 100-gallon cone bottom tank. The product is then pumped into a plate evaporator and is heated in a plate pre-heater to temperatures that vary from 100°F to 124°F-125°F. The pre-heated product then leaves the plate pre-heater and enters the plate evaporator and is evaporated with a water or steam heating the plate in the plate evaporator. The heating water has a temperature which on the average is about 155°F-160°F.

On the first pass, the product is concentrated from about 26 to 31 degrees brix. In a second pass the product is concentrated to about 31 to 35 degrees brix. In the third pass, the product increases to about 35 to about 40-41 degrees brix. The product is recirculated such that the solids of the product increase to about 46.5 and then finally to about 48 percent. At about 48 weight percent solids, the concentrated liquid whole egg product begins to become quite plastic in nature and not very flowable.



	1 <sup>st</sup> Pass egg start				2 <sup>nd</sup> Pass											
	10:00 AM	10:05 AM	10:30 AM		11:00 AM	11:30 AM	11:45 AM		2:30 PM	3:00 PM	3:05 PM	3:10 PM	3:14 PM	3:18 PM	3:25 PM	3:30 PM
Time																
Feed (°Brix)	water	26.5	26.5		31	31			36	37						
Concentrate (°Brix)		32	31		35.5	35	37		37	39	41	43	44	46.5	46	46
Feed Rate(gpm)	3		1.5		2	2	2		4	4	3.75			4	4.25	4.25
Steam Temp(°F)	130		148		158	158	200*		126	152	158			161	160	16
Steam Press ("Hg)	21		16		15	15	0		21.5	16.5						
Vapor Temp(°F)	98		98		98	98	98		93	93	92			93	92	92
Vapor Press ("Hg)	26		26		26	26	26		27	27						
Evap. Rate (lb/hr)	372		348		278	264			156	120	120			96		84
Feed Temp (°F)	120		100		94	104	106		111	113	120			124		126
Recirc. GCV																
CW in (°F)	50		50		50	50	50		50	50						
CW out (°F)	70		67		66	66	66		58	58						

11:45 AM - Steam Temp. @200°F.

Between 11:45 AM and 2:30 PM - breakdown/check plates/suspect fouling.

2:45 PM - Loss of power (vacuum), foam over.

\* Represents a failure in the run.